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Publikation entstand im Rahmen der Veranstaltung:
EuroITV 2005, 3rd European Conference on Interactive Television, Aalborg, Denmark, March 30-April 1, 2005

User Requirements and Design Guidance for Interactive TV News Applications

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1. Introduction

Interactive television (iTV) applications have many user interface design specifics when compared to applications for personal computers (Gawlinski, 2003). However, a lot of user interface design experience for personal computer applications has been gained and is documented in recommendations of the International Organisation of Standardisation, ISO (ISO 9241, 1995; ISO14915, 2002). Part of the ISO recommendations is applicable to iTV applications as well. The goal of the study presented in this article is the development of design guidance for iTV specific usability problems that are not covered by existing ISO usability standards. Also, standard user-centered development processes exist for software applications (Nielsen 1993; Mayhew, 1999; ISO 13407, 1999). For the development of iTV applications existing knowledge and methods from user-centered software engineering (usability engineering) can be applied to support user satisfaction. Some usability engineering methods (ISO 16982, 2002) have been applied in this study for the development of iTV applications. This article presents user requirements and user interface design guidance for interactive television (iTV) applications specifically for news programmes.

In order to develop design guidance the following steps have been carried out:

1. User requirements analysis for iTV news applications using focus groups.
2. Heuristic usability evaluation of two existing iTV news applications based on ISO 9241 and ISO 14915.
3. Development of two iTV news application prototypes based on the results from the requirements analysis and the heuristic usability evaluation.
4. Usability testing of the developed prototypes by end users.
5. Development of design guidance for iTV news applications in particular for media selection and media combination. The developed design guidance is based on the previous steps. The results presented serve the user-centered design and development of iTV news applications.

Before recommendations can be developed on how to design iTV applications it needs to be clear what to design. Therefore a content and functional user requirements analysis for iTV news applications has been carried out first and is presented as the basis for the design guidance to be developed.

2. User Requirements Analysis

2.1 Objective and Method

The general purpose of a user requirements analysis is to describe relevant characteristics of the users' needs and goals which the users want to achieve through the use of a specific system. More specifically the objective of the user requirements analysis was the identification and specification of content and functional requirements for interactive applications for TV news programmes. The method of focus groups has been selected for this objective. A focus group "…usually consists of a discussion involving small groups, led by a moderator. The goal is to gain information about user opinions, attitudes and preferences." (ISO 16982, 2002). Two focus groups have been carried out each which heterogeneous participants. Both focus groups together consisted of 15 participants with an average age of 36 years. None of the participant had ever seen an iTV application probably because hardly any German household receives iTV. In the focus groups two scenarios have been used to support the participants' brainstorming and to help them relate to real world situations. Scenarios are stories consisting "…of a setting, or situation state, one or more actors with personal motivations, knowledge, and capabilities, and various tools and objects that the actors encounter and manipulate. The scenarios describe a sequence of actions and events that lead to an outcome." (Rosson, 2003). Both scenarios described two concrete use cases in form of short stories. The following questions served to structure the focus groups:

1. Which additional information and functions are interesting with regard to TV news programs?
2. How could these content items and functions be categorised?
3. What is the priority of the single content items and functions within each of these categories?
4. How should the content and functions be designed and how could they be accessed and used?

The focus group sessions were subdivided into four phases. The first phase was a warm-up phase to find an easy start in the session. The participants had to reflect upon their personal TV reception and behaviour. In the second phase, called "Input", the participants got a short introduction on iTV in general. Instead of live applications or screenshots of existing applications hand scribbles have been shown to reduce biasing the participations in their imagination and expression. We wanted to allow for more freedom in creating new ideas by using hand scribbles. However, due to their unfamiliarity with iTV we found it necessary to give them some rough idea. In phase three the scenarios in form of short stories were presented to the participants. In phase four the participants were asked to put themselves in the position of the person described in the scenarios. This was followed by a brainstorming in which they developed ideas of possible content and functions for iTV news applications. These ideas were written down and put on a pinboard by the focus group moderator. Then the single content items and functions were categorised on the pinboard in a group discussion. At last the participants individually put priorities on those content items and functions that they personally find the most interesting.

2.2 Results

The collected content items and functions were partly very concrete (e.g. “select the speech” or “additional information on the news”), others would be difficult to realise (e.g. “talking to a virtual newsreader”). The results of the focus groups can be summarised in a catalogue.

Content user requirements:

1. *Permanent availability*: The news service should be available 24 hours a day.

2. *Topicality*: News and daily information should be regularly updated and relevant to the present.

3. *Broad range of topics*: The iTV news application should serve as broad information pool. It should complement the TV news programme and offer background information.

4. *Personalisatio*n: The variety and range of topics will lead to a surplus of information. Not all topics may be interesting for all users. One user e.g. is very interested in a specific topic and he wants access to relevant news over a longer time period. Therefore users should be provided with functions allowing to adept the application to personal content preferences.

Functional user requirements:

5. *Communication*: Communication is a fundamental need of human beings. Talking about experiences and events is part of everyday life. iTV applications presenting news should take this into account and offer opportunities to get in contact with other users.

6. *Alternative forms of user interface*: iTV applications can be presented in different ways, e.g. as overlay, embedded, full screen application or as ticker. People with visual impairments should be provided with zooming possibilities. Users should be able to choose among different media formats (audio, video, text) according to their needs and preferences.

7. *Alternative forms of complexity*: The choice on the user interface is linked to the choice on information complexity. Choosing a certain user interface has consequences for the perceived quantity of presented information. Different user interfaces can offer different content and functionalities. Users should have the chance to choose the degree of detail of presented information.

8. *Clear user interface design*: User interface design should be of clear structure and conform with ergonomic requirements. A clear separation between content and navigation elements is important.

9. *Efficient interaction*: Clear and fast interaction with the iTV application is of prime importance for effective use and satisfaction.

3. Heuristic Usability Evaluation of Existing ITV News Applications

3.1 Objective and Method

In order to develop design guidance for iTV news applications we conducted a heuristic usability evaluation of existing iTV news applications (Nielsen & Molich, 1990). Goal of the heuristic usability evaluation was to identify typical usability problems of present iTV news applications for which design guidance is needed. Heuristic usability evaluation consists of having a small set of evaluators examine an user interface and judge its compliance with recognized usability principles, the "heuristics" (Nielsen & Mack, 1994). In our study selected principles of ISO 9241 ("Ergonomic requirements for office work with visual display terminals") and ISO 14915 ("Software ergonomics for multi-media interfaces") served as heuristics to evaluate two present iTV news applications. Before using these ISO standards as heuristics we analysed their general suitability for iTV applications. Table 1 shows the results of our analysis. ISO 14915-2 provides user interface design guidance distinguishing three aspects: content, media and interaction design. "Media design focuses on making use of particular media objects to implement the content and interaction design… Interaction design focuses on the presentation of content to users and the methods that will be provided to users for them to interact with this content." (ISO 14915-2, 2003). We identified the general and the specific software recommendations of the standards ISO 9241 and ISO 14915 as applicable to media design and interaction design of iTV applications (Table 1). The requirements of ISO 9241 standard series concerning environment (part 5 and 6) and hardware (parts 3, 4, 7, 8 and 9) are not applicable to iTV applications because they are very desktop computer specific.

<table>
<tr><th></th><th>Media Design</th><th>Interaction Design</th></tr>
<tr><td rowspan="4">General recommendations</td><td colspan="2">ISO 9241-2*</td></tr>
<tr><td colspan="2">ISO 9241-10*</td></tr>
<tr><td colspan="2">ISO 9241-11*</td></tr>
<tr><td colspan="2">ISO 14915-1*</td></tr>
<tr><td rowspan="5">Specific recommendations of software parts</td><td>ISO 9241-12**</td><td></td></tr>
<tr><td></td><td>ISO 9241-13**</td></tr>
<tr><td></td><td>ISO 9241-14**</td></tr>
<tr><td></td><td>ISO 14915-2**</td></tr>
<tr><td>ISO 14915-3**</td><td></td></tr>
</table>

* fully applicable

** partly applicable

Table 1: Applicability of ISO 9241 and ISO 14915 as guidance for media design and interaction design of iTV applications

3.2 Evaluated Applications

Two iTV news applications have been selected: ARD Interactive TV Portal (Germany) and Sky News Active (UK). Both applications are 24/7 services, that are iTV applications that are accessible 24 hours 7 days a week. They do not enhance a specific TV programme. Both selected applications are designed as full screen applications with embedded reduced video area. ARD Interactive TV Portal offers information in form of text and images (Fig. 1), whereas Sky News Active additionally offers video channel switching (Fig. 2).

Fig. 1: ARD Interactive TV Portal (Germany, 03/05/04)

Fig. 2: Sky News Active (UK, 02/04/04)

3.3 Results

We identified two kinds of usability problems. On the one hand we discovered usability issues that can easily be solved following the ISO principles. For example the application of Sky News Active does not show the relative position of content as required by the ISO 9241-12 §5.5.3. On the other side the results of the heuristic evaluation identified design and usability issues that cannot be solved with the help of the selected ISO principles. Especially the principles concerning selection and combination of media (ISO 14915-3, 2002) cannot easily be applied to the design of iTV applications because the described media contact points are not always applicable to iTV applications. E.g. in case of ARD Interactive TV Portal the TV programme and iTV application are not necessarily associated with each other. The user may read a political headline in the iTV news application while watching a football game. Due to these findings we concentrated our following work on the design and usability issues concerning selection and combination of media in iTV news applications.

4. ITV News Prototypes

4.1 Objectives and Method

Goal of the prototype development was to identify proven design solutions for media selection and combination for iTV news applications. Different prototypes with different versions each should be developed to be able to carry out a comparative usability test with them. Based on the usability tests results it was hoped to be able to develop iTV specific design guidance for media selection and combination. We developed two prototypes which according to Nielsen's prototyping model can be called T-prototypes (Nielsen, 1994). T-prototypes are a combination of a horizontal and a vertical prototype. A horizontal prototype provides most of the user interface but lacks the functional or content depth. A vertical prototype is a working system developed for one specific part of the required functionality, e.g. searching. Other parts of the application are hardly or not implemented. Because we identified the media selection and combination as usability issue that is not sufficiently covered by existing ISO standards we varied the prototypes in horizontal direction only. To

evaluate the impact of media selection and combination on usability in a usability tests the following variables were constituted:

- *Independent variables*: Their impact should be verified and therefore they are varied.
  In our study we varied the media selection and combination and the number and presentation (sequential or concurrent) of media.

- *Dependent variable*: This variable depends on the influence of the independent variable and disturbances. Because the impact of the independent variables on the usability of the iTV news prototypes should be investigated, usability is the dependent variable.

- *Disruptive variable*: All variables with influence on the dependent variable. Their influence must be controlled, e.g. the environment where the usability test takes place.

- *Constant variable*: A variable with only one characteristic is constant. In our study navigation with the colour keys, arrow keys and number keys on the remote control, the menu structure and overall application structure, colour scheme, layout and embedded video area as ¼ screen was designed in a uniform way.

4.2 Prototype Design

We developed two prototypes for an iTV news application in the style of the ARD Interactive TV Portal. For the first prototype we built two different versions and for the seconde prototype four versions. In the first prototype we varied the entrance into the application by offering text headlines in one version (prototype 1, version A) and video streams instead in the second version (prototype one, version B). Screens of the two versions of prototype 1 are shown in fig. 3 and fig. 4.

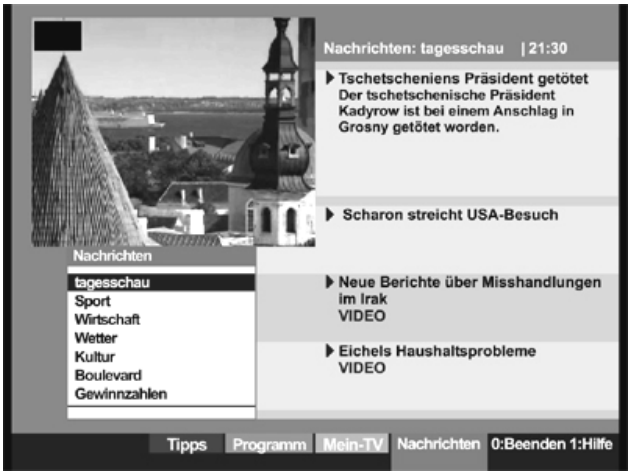

Fig. 3: Prototype 1, Version A

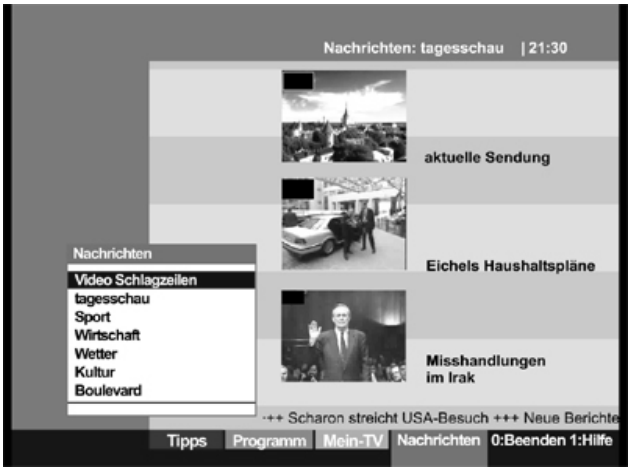

Fig. 4: Prototype 1, Version B

In prototype 2 the presentation of a single news item was varied with regard to media selection (Fig. 5). Version A presented text and the TV programme while version B showed only text and a still image instead of the video but continued the sound of the TV programme in the background. Version C and D offers an additional video instead of still image and selecting the menu point "play" starts the video. Version D was the same as Version C but the sound of TV programme was

faded out. For the prototype implementation the multimedia authoring tool Macromedia Flash MX has been used.

Fig. 5: Prototype 2: Version A (TV programme), Version B (still image), Version C (still image with video option), Version D (still image with video option and sound of TV programme is faded out)

5. Usability Testing of the Developed Prototypes

The usability tests have been carried out in the usability lab of the Institute of Media Technology at the Technical University of Ilmenau, Germany. The developed prototypes have been tested with by six test users each. The applications were displayed on a standard TV screen and the users navigated through the applications using a standard TV remote control. For the usability tests the methods of user observation, thinking-aloud, qualitative interview and video/audio analysis have been applied (Nielsen, 1993; Dumas, 2003). The test session consisted of three phases. In the first phase the users should freely explore each prototype and get familiar with the navigation using the remote control. In the second phase the different prototype versions were presented without asking the user to perform specific tasks. Following the thinking-aloud protocol the participants were asked and encouraged to "…continuously verbalize their ideas, beliefs, expectations, doubts, discoveries etc. during their use of the system under test." (ISO 16982, 2002). In the third phase of the test session the users were interviewed on their experience and opinion after using the prototypes. The results of the usability tests form part of the developed design guidance for iTV news applications.

6. Design Guidance for ITV News Applications

The following recommendations derive from the user requirements analysis, from the results of the heuristic usability evaluation of existing iTV news applications and from the usability testing of the developed iTV news prototypes. The recommendations refer to media selection and combination in particular and apply to the media design of iTV news applications. Interaction design is considered as long as it is a matter of multimedia control and navigation. The developed recommendations are to be understood as iTV specific extensions and specifications of ISO 14915-2 and ISO 14915-3. Following the structure of ISO 14915-3 they are categorised in "Overall Structure", "Media

Selection", Media Combination and "Media Control and Navigation". In the following the most important recommendations are summarised.

6.1 Overall Structure

- News content needs to meet high quality standards. Users transfer their quality expectations from TV news programmes onto iTV news applications.

- ITV news applications should be a permanently available 24/7 service.

- News should be categorised to offer clear access to a broad range of expected news topics. News should be ordered in topics (e.g. politics, economics, sports, culture, world news, national news, local news) and in topicality (e.g. today, yesterday, last week, last year).

- Access to news categories should be offered by text menus or by video/audio sequences or video menu. Text enables a fast overview, whereas video/audio sequences support the passive "lean back" TV experience. The single video streams in a video menu should be accompanied by a text title indicating the news category.

- The visual presentation should be divided in consistent areas for navigation and content through the application. This is important for orientation and perception and supports conformity with user expectations (ISO 9241-10, 1996). Full screen with embedded video stream is a suitable screen layout for iTV news application.

6.2 Media Selection

- *Text*: Text is the most important media for news information presentation. With text the speed of perception is regulated by the user and reading a text is faster than watching a video.

- *Ticker:* News tickers offer a fast overview and update. To support individualisation the user should be able to control the ticker speed.

- *Still images*: Still images should be presented as supplementation to text. Images should never be presented without description.

- *Video and audio*: Video/audio sequences should be presented as supplementation to text. The video/audio sequences should be subordinate in priority to the text. Since the speed of video/audio perception is controlled by the author only text offers the user to choose his perception speed. The decision to offer a video/audio sequence should depend on the specific news item. Some events demand a dynamic presentation, e.g. natural disasters. It needs to be considered that selecting and controlling video/audio sequences demands high user activity and involvement. Therefore the user expectations on the benefit of audio/video sequences need to be met.

- *Video and audio*: Duration of pre-recorded video/audio sequences should be visualised in form of a progress bar to support self-descriptiveness (ISO 9241-10 §3.4, 1996).

- *Video and audio*: In a video menu that displays more than one more video stream the presently selected video stream needs to be graphically highlighted. Audio should be played from the selected video stream only.

6.3 Media Combination

ISO 14915-3 §5.14 suggests design for simplicity. The minimum amount of media types should be used required to transfer the information needed for the user to fulfil his task. Linear TV itself and especially a TV news programs already is a combination of different media: Video, audio, realistic and unrealistic images and sometimes text headlines and tickers. When designing iTV news applications this needs to be considered.

- *Text and TV video stream*:
  The combination of text and TV live stream is closest to the user expectations for iTV news applications. Starting an interactive application the users expect still to be able to see the TV video stream although it is hardly possible to follow a verbal audio sequence while reading a text (ISO 14915-3, p. 45). The user usually follows only one of the presented media at a time. However, attention may change between the two especially since the topic of the two sources of information does not necessarily need to be same. It is therefore recommended to embed the TV video stream in the iTV news application. Also, this enables a user watching in a group to fulfil his needs for textual information while the other viewers continue to follow the TV programme.

- *Text and still image*:
  Text and language usually are followed one after the other. The perception of still images, however, often depends on the size and complexity of the image, on the knowledge of the viewer about the topic as well as on the user's task and motivation (Norman & Shallice, 1986). Text and still image should complement each other. Still image and text do not compete in regard of the user's attention.

- *Text and pre-recorded video*:
  While text and TV video stream are not necessarily on the same topic text and pre-recorded video should complement and refer to each other. The user should be given the possibility to read the text separately from following the video/audio sequence. Therefore the video/audio sequence should not start automatically, but be at the user's control. This supports individualisation of the application (ISO 9241-10, 1996) as well as human perception capabilities.

6.4 Media Control

- The amount of presented information and the control of dynamic media should be under the user's control.

- Controlling video/audio sequences can be done with "play", "stop", "pause", "rewind" or "forward". Because news items are usually presented in short sequences some of these functionalities do not seem adequate. Controlling video/audio sequences should demand little user activity and forced decision-making to support a "lean back" TV experience.

- If a user decides to watch a video sequence the presentation should replace the present TV programme or any other video sequences. Deciding to watch a video sequence the user does not expect to be affected by other dynamic media. Declaring the duration of the sequences in advance the user can decide whether and when he wants to start the sequences.

7. Conclusion

The chosen method of user requirements analysis, heuristic usability evaluation of present iTV applications, prototype development and usability testing has proven suitable for the development of design guidance for iTV applications. The study presented in this article is part of a larger effort to develop user interface design guidance for different types of iTV applications. Other application types include sports, documentaries, music and entertainment shows. Our future research will document the developed design insight and guidance in form of a interaction design pattern collection for iTV applications. It is our research objective to provide guidance on using proven solutions for recurring iTV design problems.

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